CLAIMS

1. A beam refraction apparatus, comprising:

an input fiber that carries an input beam;

a wavelength dispersive element coupled to the input fiber, the wavelength dispersive element spreading the input beam in at least one dimension as a function of wavelength and generating a dispersed beam;

a controllable grating reflecting the dispersed beam to the wavelength dispersive element and generating a recombined beam, the controllable grating providing a controllable reflectivity as a function of wavelength;

an output fiber that receives the recombined beam; and

a collimating optical member coupled to the input and output fibers that passes the input beam and the recombined beams in parallel and opposite directions.

2. The apparatus of claim 1, wherein the collimating optical member is a dual fiber collimator.

3. The apparatus of claim 1, wherein the collimating optical member includes a prism.

4. The apparatus of claim 1, wherein the collimating optical member includes a pair of mirrors.

5. The apparatus of claim 1, wherein the collimating optical member includes at least one cylindrical lens.

6. The apparatus of claim 1, further comprising:

a walk-off crystal positioned adjacent to the collimating optical member.

7. The apparatus of claim 6, further comprising:
a half-wave plate positioned adjacent to the walk-off crystal.

8. The apparatus of claim 1, further comprising:
a reflector positioned along an optical path of the collimating optical member, the reflector directing at least a portion of the input beam to the controllable grating.

9. The apparatus of claim 1, wherein the reflector is a turning mirror.

10. The apparatus of claim 1, wherein the wavelength dispersive element includes at least one microelectromechanical device.

11. The apparatus of claim 10, wherein the microelectromechanical device includes one or more micro mirrors.

12. The apparatus of claim 10, wherein the microelectromechanical device includes one or more cantilevers.

13. The apparatus of claim 10, wherein the microelectromechanical device includes one or more light controlling devices.

14. The apparatus of claim 10, wherein the microelectromechanical device includes one or more one or more deformable grating modulators.

15. The apparatus of claim 1, wherein the controllable grating is an array with a diffraction efficiency that is controlled as a function of position on the array.

16. The apparatus of claim 1, wherein the controllable grating is an array of ribbons.

17. The apparatus of claim 1, wherein the controllable grating is a micromachined grating device.

18. The apparatus of claim 1, further comprising:

a lens positioned between the wavelength dispersive element and the controllable grating.

19. A beam refraction apparatus, comprising:

an input fiber that carries an input beam;

a wavelength dispersive element coupled to the input fiber, the wavelength dispersive element spreading the input beam in at least one dimension as a function of wavelength and generating a dispersed beam;

a controllable grating reflecting the dispersed beam to the wavelength dispersive element and generating a recombined beam, the controllable grating providing a controllable reflectivity as a function of wavelength;

an output fiber that receives a first portion of the recombined beam from the controllable grating;

a detector array positioned to receive a second portion of the recombined beam from the controllable grating.

20. The apparatus of claim 19, further comprising:

a focusing lens positioned between the detector array and the controllable grating.

21. The apparatus of claim 20, further comprising:

a collimating optical member coupled to the input and output fibers that passes the input beam and the first portion of the recombined beams in parallel and opposite directions.

22. The apparatus of claim 19, wherein the wavelength dispersive element includes at least one microelectromechanical devices.

23. The apparatus of claim 22, wherein the microelectromechanical device includes one or more micro mirrors.

24. The apparatus of claim 22, wherein the microelectromechanical device includes one or more cantilevers.

25. The apparatus of claim 22, wherein the microelectromechanical device includes one or more acousto-optic modulator.

26. The apparatus of claim 22, wherein the microelectromechanical device includes one or more light controlling devices.

27. The apparatus of claim 22, wherein the microelectromechanical device includes one or more one or more deformable grading modulators.

28. The apparatus of claim 19, wherein the controllable grating is an array with a diffraction efficiency that is controlled as a function of position on the array.

29. The apparatus of claim 19, wherein the controllable grating is an array of ribbons.

30. The apparatus of claim 19, wherein the controllable grating is a micromachined grating device.

31. A dynamic channel equalizer, comprising:

an input fiber that carries an input beam;

a wavelength dispersive element coupled to the input fiber, the wavelength dispersive element spreading the input beam in at least one dimension as a function of wavelength and generating a dispersed beam;

a controllable grating reflecting the dispersed beam to the wavelength dispersive element and generating a recombined beam, the controllable grating providing a controllable reflectivity as a function of wavelength;

an output fiber that receives a first portion of the recombined beam from the controllable grating; and

a beam expander coupled to the input fiber makes the input beam and makes it larger in one direction and compresses the output beam.

32. The apparatus of claim 31, wherein the wavelength dispersive element includes at least one microelectromechanical device.

33. The equalizer of claim 32, wherein the microelectromechanical device includes one or more micro mirrors.

34. The equalizer of claim 32, wherein the microelectromechanical device includes one or more cantilevers.

35. The equalizer of claim 32, wherein the microelectromechanical device includes one or more light controlling devices.

36. The equalizer of claim 32, wherein the microelectromechanical device includes one or more one or more deformable grating modulators.

37. The apparatus of claim 31, wherein the controllable grating is an array with a diffraction efficiency that is controlled as a function of position on the array.

38. The apparatus of claim 31, wherein the controllable grating is an array of ribbons.

39. A dynamic spectral compensation spparatus, comprising:

a sensor that measures power in a selected spectral region and produces a signal in response to the measured power; and

a dynamic gain equalizer that receives the signal from the sensor, and modifies the selected spectral region by attenation in a wavelength dependent manner until the selected spectrum region reaches a target spectrum, wherein the selected spectrum region is modified in response to the received signal.